

ABSTRACT

An electrical heater utilizes negative temperature coefficient material (NTC) and current imbalance between live and neutral ends of the heater to simultaneously protect the heater from the hot spot and mechanical intrusion into the heating cable. The NTC layer, separating the heating wire and current leakage conductor, becomes electrically conductive at the temperatures above 60°C, thus “leaking” the current to earth. The hot spot is detected by measuring the current imbalance between line and neutral connections of the heating cable. The mechanical intrusion into the heater, such as cable or insulation damage, water or sharp metal object penetration, is also simultaneously measured by the same current imbalance measuring system such as Ground Fault Circuit Interrupter (GFCI). The optional return conductor and metal foil/mesh hot spot detection shields cancel electromagnetic field. The heater may contain positive temperature coefficient (PTC) continuous sensor to control the temperature in the heater. Such PTC sensor can be made of electrically conductive fibers and/or metal wires.